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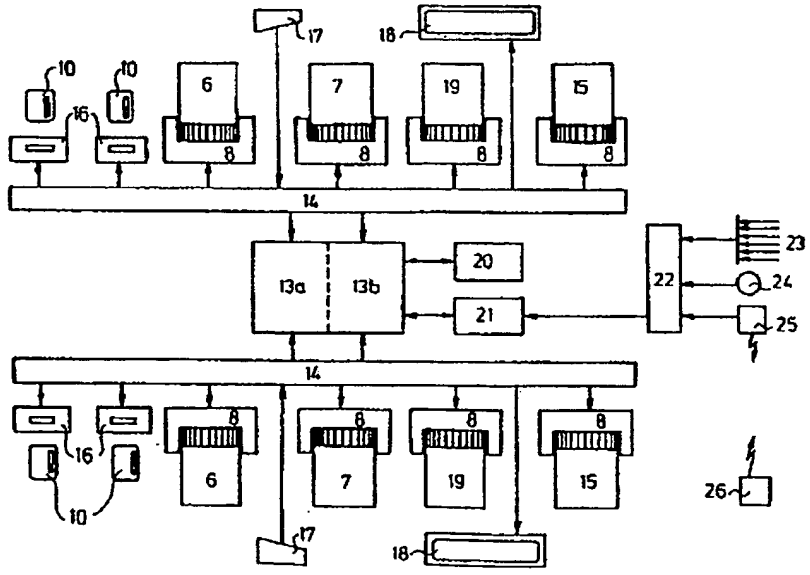
(54) Data-processing and on-board information system for railway operation

(57) The system contains stationary computers and mobile on-board computers able to communicate with one another, the stationary computer being a commercially available microcomputer with a keyboard, a display, a printer, a diskette memory and an interface for the connection of a large-scale electronic data-processing computer. At least one data module read-out apparatus (8) is connected to the stationary computer *via* an interface (9). The on-board computer contains a central unit (13), a clock generator, data modules connected to the central unit (13) *via* a bidirectional bus system and independent interfaces (14): the onboard computer also contains a locomotive data module (6), a train data module (7), a personnel data module (10), a line data module (19), and also a location identificiation module (25), connected to the central unit (13) *via* the interface (14), a sensor adaptor unit (22), display (18) and keyboard (17). A path signal transmitter (24) is connected to an axle of a locomotive belonging to the system, the output of this transmitter being connected to the input of the location identification module (25), and the location identification transmitters of the system are distributed along the railway lines at a defined distance from one another.

Fig.2



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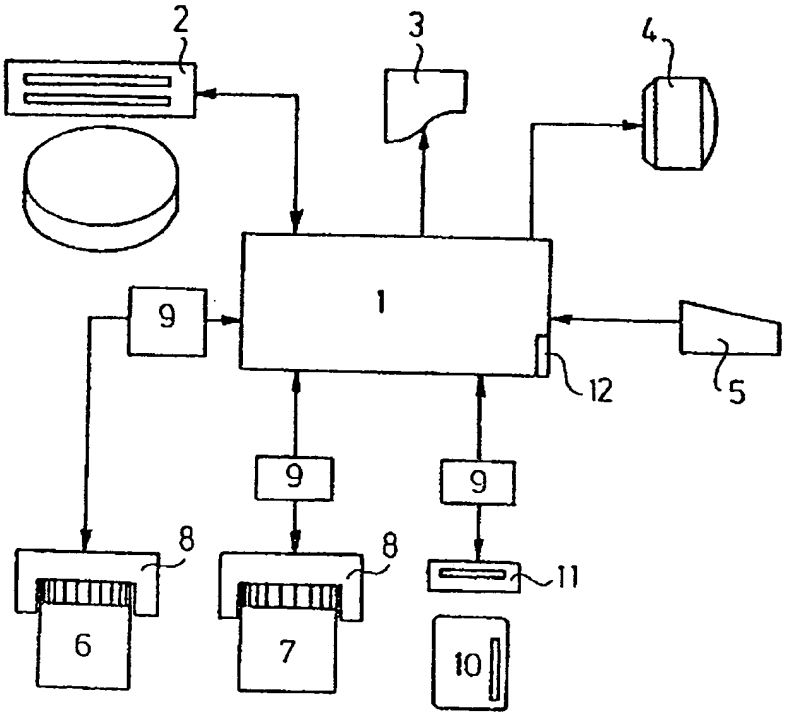

Fig. 1

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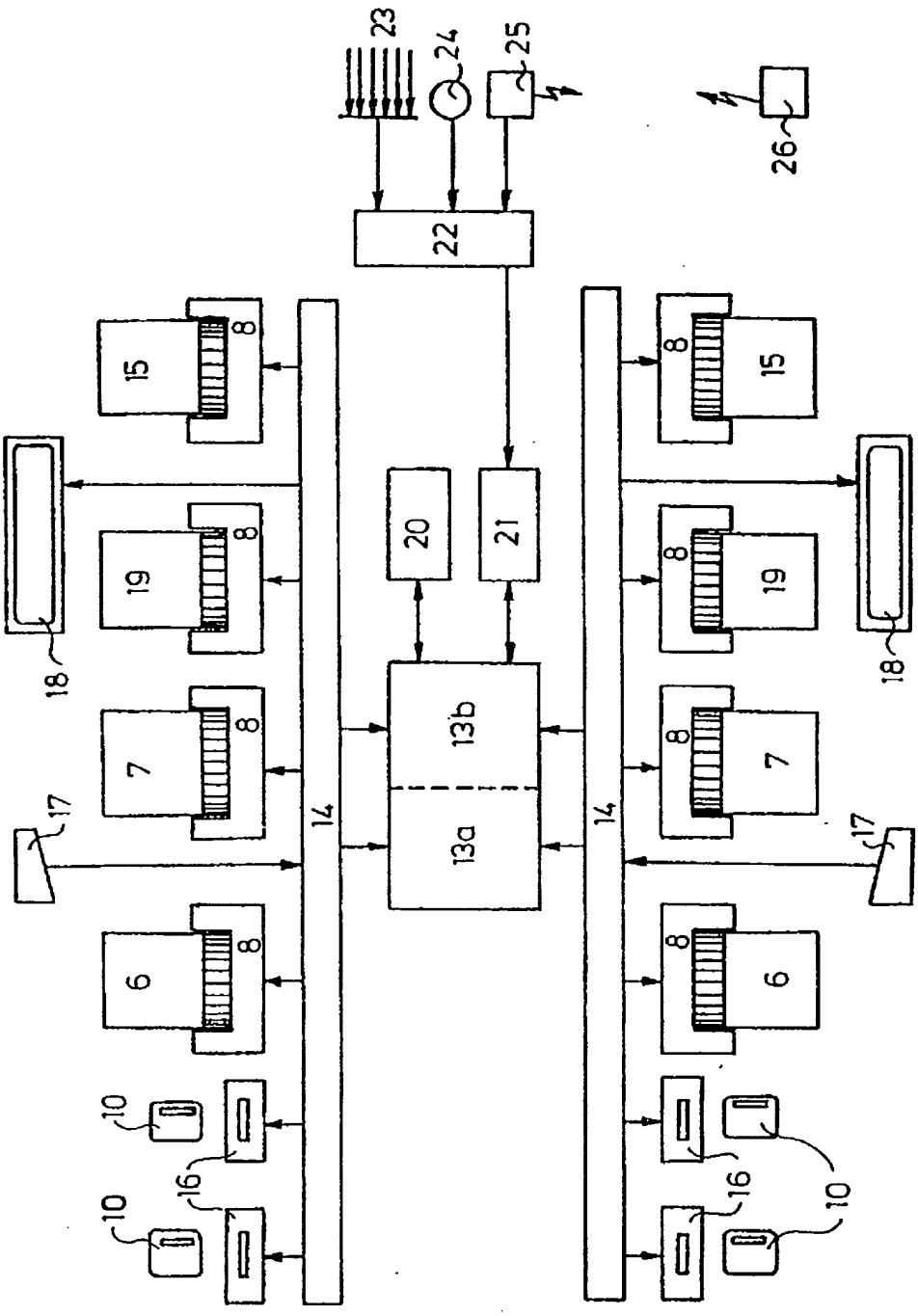

Fig.2

SPECIFICATION

Data-processing and on-board information system for railway operation

The invention relates to a data-processing and on-board information system for railway operation that contains a plurality of stationary computers and mobile on-board computers able to communicate with one another, the stationary computer being a commercially available microcomputer having a keyboard, a display, a printer, a diskette memory and an interface for connection to a large-scale electronic data-processing computer.

The prior art discloses numerous such computer-aided or largely computer-controlled traffic systems which serve for the systematic organisation of the vehicles belonging to the system and also for the collection and processing of information obtained during operation. A common feature and simultaneously a common disadvantage of these systems is that they have been developed for vehicles having constant or almost constant operating characteristics, so that the functioning of the system can be interrupted or stopped by any kind of chance event, and the loss of operation which may occur can be eliminated only by human, manual intervention. The known systems are fundamentally unsuitable for solving the problems of railway operation, since railway operation presupposes a network having dynamic, continually changing and often random parameters in which the occurrence of individual events and the changes produced thereby cannot be anticipated or guarded against.

The aim of the invention is to provide a data-processing and on-board information system for railway operation which eliminates the above-mentioned shortcomings and allows the data-processing to be automated. This system also allows the development of a system for the calculation of the working efficiency of the employees, the collection and processing of data relating to the maintenance of the traction vehicles, and the monitoring and evaluation of the utilisation of the traction vehicles in service and the train traffic conditions. The system according to the invention brings about a reduction in the energy consumed in running trains and an increase in operating reliability through the development of optimum running schedules.

The invention is based on the idea of constructing the data-processing and on-board information system in the manner of a network with stationary and mobile mini-computers or microcomputers able to communicate with one another, the computers being of the same or almost the same construction. These computers, on the basis of information collected by the sensors, signal converters and peripheral apparatus connected thereto, ensure optimum operation determined by the software and collect the data for the purpose of its further processing.

If each unit is active only within a certain field of action, then overlapping of function and, at the same time, the complexity of the individual units, can be kept at a low level. The problem posed has been solved using a system of the type mentioned at the beginning, the features of which are given in claim 1.

Other preferred embodiments are given in the subsidiary claims.

Among the most significant advantages of the system according to the invention, mention should be made of its modular construction: this modular construction is not important for reasons of hardware, as previously, but because the individual modules 'monitors' the individual objects, that is to say the personnel, the traction vehicles, the trains and so on, in functional respects. Although it is possible to use a radio link, the radio transmission of information is not a prerequisite for the operating ability of the system. Unlike known systems, the decisions arrived at on the basis of information collected, and the resulting control commands, are not produced in the stationary computers, but the information is used, on the one hand, to achieve optimum operating parameters and, on the other hand, when collected and processed in the stationary computers, to draw conclusions that are applicable to the whole system. In this way the individual trains are independent: when the trains leave the area of the system they can still benefit from most of the advantages of the syatem, i.e. operating ability of the locomotive and the work of the personnel can be observed more accurately.

By the selection of optimum running parameters, the flow of the rail traffic is accelerated, energy consumption is reduced and reliability is considerably increased.

The invention will be described in more detail below with reference to the drawing which shows a preferred embodiment of the data-processing and on-board information system for railway operation.

Figure 1 shows a general block circuit diagram of the stationary computer of the system, and

Figure 2 shows a general block circuit diagram of the mobile on-board computer matched to the stationary computer from Fig. 1.

The stationary computers of the system shown are set up at the railway control centres and the area headquarters, and optionally in the stations, their size being dependent upon the amount of data to be processed. The stationary computer contains a data memory and data processing unit 1 which in this instance is a commercially available microcomputer with corresponding central memory

capacity. The microcomputer is connected to a diskette memory 2 and various peripheral units, for example a printer 3, a display 4 and a keyboard 5, by means of corresponding adaptor units in a manner known *per se*. The diskette memory 2 with high capacity serves as a backup memory. The data memory and data-processing unit 1 is connected *via* an interface 9 to a data module read-out apparatus 8 for reading out at least one module, in this case for reading out a locomotive data module 6 and a train data module 7. The locomotive data module 6 and the train data module 7 are memory cards with standard measurements and connections which can be inserted into the data module read-out apparatus 8. The personnel data module 10, which is constructed in the form of an active memory card, can be inserted into the card write/read device 11 which is connected *via* a further interface 9 to the data memory and data-processing unit 1, the mode of communication between the personnel data module 10 and the card write/read device 11 being electromagnetic in this instance. The stationary computers at the railway control centres contain at least one card write/read device 11, and at the entrances to the buildings there are arranged several such card write/read devices 11 which are likewise connected to the data memory and data-processing unit 1 *via* interfaces 9. This data memory and data processing unit 1 has a serial interface 12 by means of which the stationary computer can be connected to a large computer located at the associated area headquarters for the purpose of further data-processing.

The block circuit diagram of the mobile on-board computer of the system is shown in Fig. 2. The on-board computer contains a microprocessor central unit 13 which is in bidirectional contact *via* interfaces 14 with the data modules, for example with the locomotive data module 6, the train data module 7, the line data module 19 and the black box module 15. The central unit 13 is likewise connected *via* the interface 14 with card writers 16 that are suitable for writing the personnel data module 10. A keyboard 17 and an alphanumeric display 18 are also connected to the central unit 13 *via* a further interface 14. The keyboard 17 contains numeral keys 0 to 9 and also some keys that are functionally assigned, and the alphanumeric display 18 in this example comprises 24 display elements 20 mm in height that are arranged in two rows and ensure reliable legibility under any circumstances. Each driver's cab of the locomotive belonging to the system is provided with an independent data-processing and display unit, which are each connected *via* an interface 14 to the bidirectional bus system of the on-board computer. Each such active data-processing and display unit contains a locomotive data module 6, a train data module 7, a line data module 19, a black box module 15, a card writer 16, a keyboard 17 and an alphanumeric display 18, and is so designed that during operation the independent data-processing and display unit installed in the other driver's cab of the locomotive is inoperative. The central unit 13 is functionally divided into two parts, namely into a central data-processing unit 13a and a central monitoring unit 13b. The central unit 13 is connected to a static data memory 20 and a dynamic data memory 21 the output of which is connected *via* a sensor adaptor unit 22 to a plurality of sensors 23, which are connected to the essential operating elements of the locomotive and which are shown only schematically in the Figure by arrows, and to a path signal transmitter 24 arranged on an axle of the locomotive. The location identification module 25 of the on-board computer is likewise connected to the input of the dynamic data memory 21.

The system shown also contains means laid along the line: at the characteristic positions of the stations, the railway control centres and on the railway line, for example, at the heating house connections; a location identification transmitter 26 is arranged at each open end of the stations, these transmitters being at least the distance of the signal lights apart and a maximum of 10 km apart. The distance between two location identification transmitters 26 is determined by the mode of transmission of the information to the locomotive. In the example shown, the location identification transmitters 26 are designed in the form of the continuously emitting inductive signal transmitters, but these location identification transmitters 26 can advantageously be constructed as radio transmitters which emit an information packet whenever a locomotive passes over them. In that case the location identification module 25 of the on-board computer contains a radio receiver which is tuned to the frequency of the radio transmitter of the location identification emitter 26.

The mode of operation of the system according to the invention is explained in the following:

The system can be divided functionally into three essential modules and structurally into four essential modules, the train data module, the locomotive data module: the personnel data module and the line module. The train data module serves for data communication and for data storage of the tasks of train monitoring, energy saving, reliability (black box function) and the supply of constant measured value data. Since energy saving can be achieved only with a knowledge of the characteristic data of the trains and the lines, the train data module should co-operate with the line data module. If desired, the train data module may contain the line data module. Characteristic information is to be understood as

being the data relating to the lines, the timetable and changes in the composition of the train. Energy-saving operation can be realised experimentally by setting up a model of the train's movement characteristics under laboratory conditions, and, on the basis of the guide algorithm developed with the aid of these models, generating drive commands for the locomotive driver in the on-board computer, the data regarding the train of the locomotive, the line and the journey being taken into consideration.

The functions of the train data module are connected with maintenance work carried out on the locomotive at its home railway control centre, and also serve for the time monitoring of the traffic data. In such a manner it is possible with each locomotive to monitor repair and maintenance work, the circumstances in which the train is out of service, the wear to relatively important parts of the locomotive and possible connections between the traffic load on the locomotive and the maintenance work that has been carried out.

The personnel data module is used for solving administrative problems, for example work administration and wage administration for the personnel engaged in running the locomotive.

Before the beginning of a journey, the locomotive driver receives the insertable train data module unit at the given station. This train data module stores the composition of the train, the code number of the station planning its composition, the train number, the train load, the braked load, the top speed, the identification number of the locomotive, the code number of its home railway control centre, the location of the connection of the locomotive to the train, the time of connection or disconnection, the code numbers of the stations through which the train passes, the associated times, the code numbers of the places where the composition of the train is to be altered, the new train load, the new brake load, the new number of axles etc.

This module contains the location of a possible change of locomotive.

The locomotive driver inserts his identification card into the on-board card reader prescribed for him, then inserts the train data module received at the station and the line data module into the connections provided for that purpose. At this time the most important data, namely the location and the time of the connection of the locomotive to the train, the identification number of the locomotive and the code number or its home railway contro centre, are transcribed automatically. After the insertion of his identification card, the station master then types in the train number, the train load, the brake load, the top speed permissible and the number of axles *via* the keyboard of the on-board computer and authorises the departure of the train.

The location identification transmitters located along the line determine when the train passes over them and, as a result, the arrival of the train at the individual stations or its departure from the stations is automatically entered and monitored. If alterations are made in the traffic conditions by human action, then these alterations are entered into the on-board computer. At the destination station, the data relating to the arrival and the disconnection of the train from the locomotive is entered into the on-board computer and then the train data module is removed from the on-board computer and handed in at the destination station. The train data modules collected are read out at the railway control centres with the aid of the stationary computers and the data collected is processed.

In the following claims, reference numbers have been inserted as an aid to the reader, these reference numbers indicating the parts shown in the attached drawings that corresponds to the features of the claim; these reference numbers are not intended to limit the claims in any way.

CLAIMS

1. Data-processing and on-board information system for railway operation, containing stationary computers and mobile on-board computers able to communicate with one another, the stationary computer being a commercially available microcomputer with a keyboard, a display, a printer, a diskette memory and an interface for connection to a large-scale electronic data-processing computer, wherein the stationary computer is connected *via* an interface (9) to at least one data module read-out apparatus (8), and the on-board computer contains a central unit (13), a clock generator, data modules connected to the central unit (13) *via* a bidirectional bus system and independent interfaces (14), *inter alia* a locomotive data module (6), a train data module (7), a personnel data module (10), a line data module (19), and also a location identification module (25) connected to the central unit (13) *via* the interface (14), a sensor adaptor unit (22), a display (18) and a keyboard (17), and wherein a path signal transmitter (24) is connected to an axle of a locomotive belonging to the system, the output of the path signal transmitter (24) being connected to the input of the location identification module (25), and wherein the location identification transmitters of the system are distributed along the railway lines at a defined distance from one another.

2. System according to claim 1, wherein the location identification transmitters are inductive transmitters that emit the identification signals continuously.

3. System according to claim 1, wherein the location identification transmitters are constructed in the form of radio transmitters that emit RF-burst signals and that are triggered by

the locomotive passing over them, and the location identification module of the on-board computer contains a radio receiver that is tuned to the transmitting frequency of the location identification transmitter.

4. System according to any one of claims 1 to 3, wherein each driver's cab of each locomotive belonging to the system contains an independent data-processing and display unit, which are each connected *via* an interface (14) to the bidirectional bus system of the on-board computer.

5. System according to any one of claims 1 to 4, wherein the functional units of the on-board computers are of modular construction.

6. System according to any one of claims 1 to 5, wherein the central unit (13) of the on-board computer is divided into a central data-processing unit (13a) and a central monitoring unit (13b), and a static data memory (20) is connected to the bus system, and the output of the sensor adaptor unit (22) is connected to a dynamic data memory of which the output is connected to a black box module (15) which is itself a shift register memory with a continuous power supply which collects and constantly rewrites all the characteristic data of the last 5 km travelled.

7. System according to any one of claims 1 to 6, wherein the personnel data module (10), the locomotive data module (6) and the train data module (7) have a ROM memory containing constant and unchangeable characteristics, and also a RAM memory containing the variable data, the locomotive data module (6), the train data module (7), the line data module (19) and the black box module (15) being constructed in the form of standard memory cards, and the personnel data module (10) being constructed in the form of an active memory card.

8. A system substantially as hereinbefore described in connection with and as illustrated in Figs. 1 and 2 of the accompanying drawings.

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